Course Title: General Chemistry for Chemistry Majors

Course Description

As students progress through their year of general chemistry, topics are covered but often students are left with an incomplete understanding of even the most basic principles of chemistry. The goal of this course is mastery of the basic principles of chemistry. The format of the course will be novel. Lecture will revolve inquiry and around student based problem solving (see below).

During the first 10 weeks, topics will include: matter and measurement (with error analysis); atoms, ions and molecules; stoichiometry; aqueous reactions and solutions; thermochemistry; electronic structure of atoms; periodic properties of the elements; basic concepts of chemical bonding and molecular geometry.

This foundation will enable the student to study the more advanced concepts in chemistry (weeks 11-30): phases of matter; intermolecular forces; aqueous solutions; kinetics; equilibrium; acid-base chemistry; thermodynamics; electrochemistry; the chemistry of the metals and nonmetals; coordination chemistry, nuclear chemistry; materials chemistry; organic chemistry and biochemistry.

Learning outcomes

Upon successful completion of the course (this is a modified C12x)

1. Students master the basic facts, principles, theories and methods of modern science.
2. Students know key events in the history of science.
3. Students can provide examples of the inter-dependence of scientific and technological developments.
4. Students are able to discuss social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

OR (the specifics)

Upon successful completion of the course, students will be able to do the following:

- Identify the binding forces of matter.
- Understand the relationship between the structure of matter and its properties.
- Understand how the structure of the atom dictates the periodic relationships of matter.
- Identify the types of chemical reactions and the role played by energy.
- Evaluate the mass volume relationships of chemical systems.
- Demonstrate the ability to calculate and interpret results based on data obtained in the laboratory
- Understand chemical bonding and molecular geometry.

Weeks 11-30

- Evaluate the differences in gases, liquids and solids from the viewpoint of the Kinetic Molecular Theory
- Qualitatively and quantitatively describe the behavior of solutions.
- Understand the principles that affect the rate of a chemical reaction.
- Evaluate the dynamic nature of chemical equilibrium
- Understand how thermodynamics affects the plausibility of a chemical or physical process.
- Write specifics if this is the path we will take on learning outcomes….

Resources and Materials – parallel C121, C122, C123 for this first year
Textbook: Chemistry the Central Science, 11th Edition; Brown, LeMay, Bursten and Murphy, 2009, ISBN # 0-13-600617-5
Lab Manual: General Chemistry Laboratory Experiments, Volume 1 (2009-10), by Casey and Tatz
Lab Notebook: Student Lab Notebook, Hayden-McNeil Publishing, Inc.
Prerequisite: Chemistry 122.
Calculator: to be determined

Student Evaluation and Grading Policies
Grade Scale

- A: > 950 pts; A-: 900-949
- B+: 866-899 pts; B: 833-865 pts; B-: 800-832 pts
- C+: 766-799 pts; C: 733-765 pts; C-: 700-732 pts
- D+: 650-700 pts; D: 600-649 pts
- E: < 600 pts

Grade Breakdown

- Graded Homework: 50 pts
- Quizzes: 100 pts
- Lab: 150 pts
- Three Exams: 400 pts (80 pts – week 2; 160 pts @ – weeks 5 and 8)
- Final Exam: 300 pts (cumulative)

Exams will no longer reply solely on multiple choice questions – but also use essay/short answer questions. The first exam of the term will set the tone - cleanly defining for the students the expectations of this course.

Class Format
Lecture time

- Each class meeting will begin with two questions either from the students or the instructor. This engages the student immediately. The first question will be conceptual and based on the previous class meeting. The answer should be known by all in the class. The second question may not

have a definitive answer but provoke further thought and lead into the topic of the day.

- Students will participate in the introduction of the new topic (reading assigned prior to the class meeting). The concept will be stressed during this portion. Notes will be taken by the student highlighting key equations, figures and supporting experimental data.
- Examples relating to the concept will not be worked by the instructor. Instead they will be posed to the class for individual or group work during the middle part of the class meeting. This engages the student immediately and allows them to identify their problem areas. Both the instructor and the Teaching Assistants will circulate through the room to assist.
- The nature of the examples will progress from very elementary to intermediate to questions that may not have a definitive answer.
- After a given time period, the answers will be discussed by randomly calling on students to share their work.
- Answers to questions will be due before the next class meeting insuring continuity and flow.

<u>Recitation (25 student size led by lecturer)</u>

- Students will again be given a series of questions, but the questions will be more challenging. Those students ready for the challenge will proceed. Those students struggling with the original examples can be given additional help before they leave the smaller classroom setting.

This class format represents a radical change from the current lecture style course. It will require considerable course development to ensure that a topic can be covered in a specific time period and the syllabus is met during the course of the term. For some of the topics, i.e. bonding theory, specific faculty may be called upon to deliver the lecture, enhancing the experience for the student by providing them with more depth and a mechanism for meeting faculty that might not be involved in teaching general chemistry.

Notes developed from teaching general chemistry over the past 11 years will provide the basis for the lecture section of the meeting. Improvements will be made based on working knowledge from others involved in teaching general chemistry.

Many students believe they know the material yet they do not know how to use the material. Examples worked by the students will highlight the details for student focus. As students may work at various paces, it is envisioned that in time questions be available on an individual workstation. The entire class may have the same assignment or the examples may be individualized. Previous work with WebCT /Carmen resulted in a database of over 100,000 questions – many generated using algorithms to provide variations of the same problems using different sets of data. Pearson, the publisher of our current text (Brown,

LeMay, Bursten and Murray) is providing the Chemistry Department with not only on-line questions for the current text but all their texts – both lower and higher caliber. Again, the nature of the individual assignment can be geared to the ability of the student – much like the current GRE generates questions based on the ability of the student.

The success of the course is highly dependent on participation. The Instructor must have clearly defined notes, examples and questions for students to assess their knowledge. The Teaching Assistants must have a firm grasp of general chemistry to not only provide the students with the correct answer but also teach the students how to think for themselves. Students must come to class eager to learn. This can be brought about by providing both a structured and nurturing environment.

Schedule

As this will be the first time a majors class is offered, it will parallel the general chemistry sequence in overall content but most likely not in sequence. Our starting point will be Chapter 6 – The electronic structure of atoms, followed by Chapter 2 – Atoms, Molecules and Ions. Certain areas, i.e. nomenclature and stoichiometry, will be covered in a shorter time, other areas, i.e. bonding and energetics will receive additional time.

Draft - First 10 weeks – Majors Course

Week of	*Lecture Topic*	*Chapter*	*Quiz*	*Laboratory ys*
Sept. 21th	Light as a Wave, Photons, Line Spectra/Bohr Model, Quantum Mechanics and Atomic Orbitals, Representing Orbitals	Ch. 6		
Sept. 28th	Atomic Theory, Structure and Weights; Periodic Table, Molecular and Ionic Compounds, Naming Compounds;	Ch. 2		
	FIRST EXAM – Thursday, Oct 1, 2009			
Oct. 5th	Nomenclature, Matter, Measurement Units, Measurement Uncertainty, Significant Figures, Dimensional Analysis Chemical Equations	Ch. 1		
Oct. 12th	Patterns of Chemical Reactivity, Formula Weights, The Mole, Empirical Formulas from Analysis, Quantitative Information	Ch. 3,4		
Oct. 19th	Limiting Reactants, Aqueous Solutions, Precipitation, Acid-Base, Redox, Concentration, Solution Stoichiometry, Chemical Analysis	Ch. 4		
	SECOND EXAM – Thursday, Oct 22, 2009			
Oct. 26th	Orbitals, Electron Configurations, Periodic Table, Charge, Size, IE, EA	Ch. 6,7		
Nov. 2rd	Metals, Nonmetals, Metalloids; Group Trends, Chemical Bonds, Lewis Symbols, Ionic and Covalent Bonding, Polarity, Electronegativity, Lewis Structures	Ch. 7,8		
Nov. 9th *	Resonance Structures, Exceptions to Octet Rule, Covalent Bond Strength; Molecular Shapes, VSEPR, Shape and Polarity	Ch. 8,9		
Nov. 16th	Octet Rule Exceptions, Bond Energy, Molecular Shapes, VSEPR Model, Polarity of Molecules	Ch. 9		
	THIRD EXAM – Thursday, Nov 19, 2009			
Nov. 23th *	Diatomic Molecules, Energy,1st Law of Thermodynamics, Enthalpy	Ch. 9,5		
Nov. 30st	Enthalpies of Reaction, Calorimetry, Hess's Law, Formation Enthalpies	Ch. 5		
FINAL EXAMINATION -				